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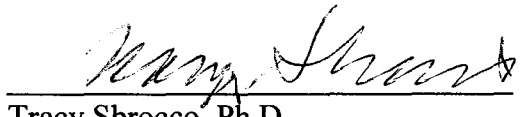

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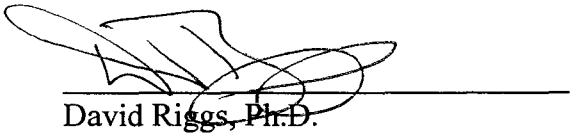

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Research has shown that overweight and disordered eating are often comorbid especially in the context of poor family functioning and negative affect. The role of family structure remains largely unexplored, and no single study has examined all of these variables at once. Overweight adolescents (N = 145) voluntarily enrolled in a double-blind, randomized, placebo-controlled safety and efficacy trial for weight-loss medication. Each participant completed a physical examination, the Family Environment Scale, the Children?s Depression Inventory, and the Eating Disorder Examination during baseline assessment.

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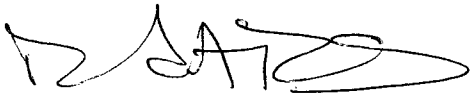

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ABSTRACT

Title of Thesis: The Impact of Family Environment on Disordered Eating in Overweight Adolescents

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Research has shown that overweight and disordered eating are often comorbid, especially in the context of poor family functioning and negative affect. The role of family structure remains largely unexplored, and no single study has examined all of these variables at once. Overweight adolescents (N = 145) voluntarily enrolled in a double-blind, randomized, placebo-controlled safety and efficacy trial for weight-loss medication. Each participant completed a physical examination, the Family Environment Scale, the Children's Depression Inventory, and the Eating Disorder Examination during baseline assessment. The majority of participants were African-American (59.3%) females (66.2%) from non-intact homes (51.0%). Family structure was not related to any other variable in the study. Family environment was inversely related to negative affect in males, and negative affect was directly associated with disordered eating behaviors and cognitions in females. Implications for prevention of pediatric overweight and disordered eating are discussed.

THE IMPACT OF FAMILY ENVIRONMENT ON DISORDERED EATING IN OVERWEIGHT ADOLESCENTS

by

CPT David A. Ross

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INTRODUCTION

Pediatric Overweight Prevalence

In the past three decades, the prevalence of pediatric overweight and obesity has dramatically increased (Ogden et al., 2006; Ogden, Carroll, & Flegal, 2008). The current overweight definitions for children and adolescents were established using age- and sex-based percentile rankings (Hamill et al., 1979; Ogden et al., 2002) for body mass index (BMI; kg/m^2), such that youth at or above the 95^{th} percentile are considered overweight and those between the 85^{th} and 95^{th} percentile are considered at risk for overweight (Dibley, Goldsby, Staehling, & Trowbridge, 1987). These standards translated into height-weight growth curves against which youth today are still compared. Recent data show that these two groups are now disproportionately large: 17.4% of children are overweight, and another 16.2% are at risk of overweight (Ogden et al., 2006).

Overweight during childhood is associated with a number of adverse health consequences. Overweight children are at greater risk for heart disease (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001; Gunnell, Frankel, Nanchahal, Peters, & Davey Smith, 1998), hypertension (Field, Cook, & Gillman, 2005), type II diabetes (Freedman, Dietz, Srinivasan, & Berenson, 1999), and possibly certain forms of cancer (Dunger, Ahmed, & Ong, 2005; Lujan Irastorza, Garcia Rodriguez, Figueroa Preciado, Hernandez Marin, & Ayala, 2006) . Such consequences have prompted researchers to explore the cause and course of overweight with the aim of preventing the condition.

Under normal physiological circumstances, overweight may be conceptualized as an energy imbalance where overall intake exceeds expenditure (Hill, 2006). Many biological, psychological, social, and behavioral factors have been identified as correlates

of both intake and expenditure, and thus have direct and indirect impact on overweight. This paper will discuss the current limited understanding of the etiology of overweight, as well as its relationship with psychopathology and disordered eating behaviors. We will describe how these psychological disturbances may be the result of emotion regulation problems, which might maladaptively result in disordered eating behaviors. Conversely, we will discuss how disordered eating, in turn, may exacerbate overweight. Further, and of key relevance to the present study, many of these relationships appear to be mediated by family functioning. By examining the association between family functioning and family structure, we will build a foundation for the current research which explores the link between family structure and both overweight and disordered eating behaviors in adolescents.

Genetic Factors of Overweight

The etiology of overweight is still undetermined. Research has shown that having one or two overweight parents is a strong predictor of child overweight (Maffeis, Talamini, & Tato, 1998; Williams, 2001), although the exact mechanism is unknown. Emerging research suggests that a number of physiological variables, such as appetitive hormones, proteins, and genes, may contribute to excess body weight. While a full discussion of physiological correlates is beyond the scope of this paper, it is notable that scientists have identified a number of overweight cases attributable to genetic conditions such as leptin deficiency and melanocortin-4 receptor mutations (Farooqi, 2005). However, these polymorphisms account for a very small proportion of overweight cases (Farooqi, 2005), warranting further investigation of factors relevant to the majority of the population. Wu and Suzuki (2006) suggest that a high-fat diet in parents may affect body-

fat accumulation in offspring through genetic inheritance, but this research is still in progress.

Research has also shown that BMI tracks from childhood through adolescence and into adulthood (Field et al., 2005; Freedman et al., 2004; Williams, 2001), and child overweight as early as three years of age predicts overweight in adulthood (Guo, Wu, Chumlea, & Roche, 2002). Once children reach the age of ten, parents' body weight becomes less influential (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997), suggesting that other influences begin to play a larger role in the development of overweight.

Psychological Correlates of Overweight

In childhood and adolescence, overweight has been associated with increased anxiety and affective disturbances. Causal relationships are difficult to determine, as research on the psychological correlates of overweight has been inconsistent. Several studies have associated depression and poor self-esteem with overweight in children and adolescents (Braet, Mervielde, & Vandereycken, 1997; Zametkin, Zoon, Klein, & Munson, 2004). This relationship is more consistent in populations seeking treatment for overweight (Flodmark, 2005; Wardle & Cooke, 2005), as some research has shown no difference in depression or anxiety between non-treatment seeking overweight and normal weight children (Tanofsky-Kraff et al., 2004). Anxiety and somatoform disorders have also been associated with overweight in a clinical sample of adolescents and young adults (Britz et al., 2000), and although binge eating was assessed, its role in the relationship between psychopathology and weight was not discussed. This is important in light of evidence that measures of depression are unrelated to BMI but are associated with measures of disordered eating. These results were found in a sample of severely

overweight treatment-seeking adolescents (Glasofer et al., 2007; Isnard et al., 2003), as well as a nonclinical sample of normal weight and overweight women (French, Jeffery, Sherwood, & Neumark-Sztainer, 1999).

One study examined children with major depressive disorder and a control group of children who were otherwise free from psychopathology, comparing their BMI in adulthood. Although the two groups had similar BMI in childhood, the depressed group had significantly higher BMI as adults, with an average of 26.1 (Pine, Goldstein, Wolk, & Weissman, 2001) which is above the 25 BMI cutoff for overweight in adulthood (Ogden et al., 2006). Moreover, in a one-year prospective study of adolescents, depression predicted obesity in those not obese at baseline and also predicted an increase in BMI among those already obese at baseline (Goodman & Whitaker, 2002). However, a longitudinal study by Tanofsky-Kraff et al. (2006) did not find childhood depressive symptoms to be a significant predictor of the development of excessive fat mass gain in children who were already overweight or who were at high risk for overweight by virtue of their parent(s)' weight. Goodman and Whitaker were able to notice an increase in BMI after one year of adolescence, and Pine and colleagues noticed the effects of childhood differences ten to fifteen years later. Given that the three studies with positive findings included some period of adolescence, and that the one without positive findings was limited to childhood, it may be that depression in adolescence effects weight gain more so than depressive symptoms during childhood.

The link between depression and overweight is most strongly demonstrated in adolescent girls. One study found depressive symptoms to be related to a greater than four-fold increased risk for obesity onset during a four-year follow-up period (Stice,

Presnell, Shaw, & Rohde, 2005). A similar study found late adolescent girls with depressive episodes were at more than two-fold increased risk of obesity in adulthood versus those without depressive episodes (Richardson et al., 2003). In a prospective study that followed children into adulthood, researchers found that among females, the presence of anxiety disorders was associated with generally higher BMIz (BMI expressed as a z-score, referent to age- and gender-based population statistics (Ogden et al., 2002)) compared to peers with no anxiety, and depression was associated with a greater yearly gain in BMIz compared to peers without depression (Anderson, Cohen, Naumova, & Must, 2006).

Overweight and Disordered Eating

Eating disorders and sub-threshold disordered eating patterns are common among overweight children and adolescents. Of the eating disorders described in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association [APA], 2000), a provisional diagnosis, namely binge eating disorder (BED), is most commonly associated with overweight and obesity. Currently subsumed under the category Eating Disorder Not Otherwise Specified, diagnostic criteria have been proposed and research of the disorder continues to increase. BED is characterized by recurrent binge eating in the absence of regular compensatory behavior. An episode of binge eating is defined as eating a large amount of food given the circumstances accompanied by a sense of loss of control over eating. This behavior is commonly associated with overweight, and it was reported by 36.5% of Decaluwe, Braet, and Fairburn's (2003) sample of overweight children and adolescents.

Beyond binge eating, there are several other behaviors and cognitions that indicate the possibility of disordered eating. In a sample of non-treatment seeking overweight children, 60% reported dieting at least once in their lives, and 30% reported ever experiencing loss of control eating in the absence of a large amount of food (Tanofsky-Kraff, Faden, Yanovski, Wilfley, & Yanovski, 2005). In addition to a higher percentage of loss of control eating behaviors, Tanofsky-Kraff et al. (2004) found that overweight children also report greater eating restraint as well as greater concern with eating, shape, and weight than do non-overweight children. Additionally, this study identified loss of control during eating (regardless of the reported amount of food ingested), compared to overeating without loss of control or not overeating at all, as being related to higher BMI and greater body fat mass in children.

Disordered eating attitudes and behaviors typically co-occur and are associated with BMI and fat mass in samples of overweight and non-overweight children (Morgan et al., 2002; Tanofsky-Kraff & Yanovski, 2004). However, because there are multiple weight measures and indicators of disordered eating, and because not all researchers use the same measures, results are not entirely consistent across studies. Longitudinal research involving adolescents suggests that binge eating predicts obesity onset (Stice, Cameron, Killen, Hayward, & Taylor, 1999), and that dieting and other weight loss strategies promote weight gain (Field et al., 2003; Stice et al., 1999). Another study reports that although binge eating and dieting predict increases in body fat, disturbed eating attitudes do not (Tanofsky-Kraff et al., 2006). Despite some inconsistencies between which behaviors and cognitions lead to changes in particular measures of

overweight, a link between disordered eating and overweight appears to be an established phenomenon.

Psychological Correlates of Disordered Eating

Given that emotional distress may be elevated in overweight individuals, and that overweight is often associated with disordered eating behaviors, it is not surprising that psychopathology has also been identified alongside many diagnoses of eating disorders and likewise with the presence of sub-clinical disordered eating behaviors and cognitions. Because BED is only a putative diagnosis and therefore is only beginning to be examined, we will look to literature describing other eating disorders, as well as sub-threshold symptoms, to determine the psychological correlates of disordered eating. Major depressive disorder is present at some point during the life of 57% of patients with anorexia nervosa (AN), 73% with bulimia nervosa (BN), and 79% with both AN and BN (Fornari et al., 1999). Among adult women, one study found the presence of one or more anxiety disorders in 55% with AN, 68% with BN, and 62% with AN and BN (Kaye, Bulik, Thornton, Barbarich, & Masters, 2004).

Similar associations are found when examining sub-threshold symptoms, including specific disordered eating behaviors and depressive cognitions. Among treatment-seeking overweight children and adolescents, those reporting binge eating display more concerns about eating, weight, and shape, and have lower self-ratings of physical appearance and global self-worth than those without binge eating (Decaluwe, Braet, & Fairburn, 2003). In overweight adolescents, severity of binge eating tends to be correlated with higher levels of depression and anxiety, and lower self-esteem (Glasofer et al., 2007; Goossens, Braet, & Decaluwe, 2007; Isnard et al., 2003). Another study has

confirmed the co-occurrence of depression and binge eating among overweight children and adolescents, but did not find any differences based on degree of overweight (Decaluwe et al., 2003). Further, adolescents who meet research criteria for BED and those who endorse recent binge eating report greater eating-related psychopathology, have more disturbed mood, and are more anxious than adolescents reporting loss of control eating in the more distant past or never (Glasofer et al., 2007).

Among overweight children not seeking treatment, research has shown that those who report loss of control over eating have higher scores on self-report scales of anxiety, depression, and disturbed eating attitudes (Morgan et al., 2002), as compared to peers who do not report loss of control. Another study of non-treatment seeking overweight children reported that those who reported loss of control over eating also had higher scores on the ineffectiveness and negative self-esteem subscales of a self-report depression inventory, and had higher scores on an interview assessing restraint and concerns with eating, shape, and weight (Tanofsky-Kraff et al., 2005). In a cross-sectional study of adolescent girls, symptoms of depression and anxiety correlated with dieting behaviors, which included behaviors such as calorie counting, reducing food quantity, and meal skipping (Patton et al., 1997).

Overweight and Family Functioning

Few longitudinal studies have examined family qualities that may be predictive of overweight. One study found that lack of parental support and poor personal hygiene in children was strongly associated with overweight in adulthood (Lissau & Sorensen, 1994). Johnson and colleagues (2002) also examined obesity onset during adolescence or young adulthood based on measures of childhood adversity. Physical neglect during

childhood was a significant risk factor in the development of obesity and recurrent weight fluctuations. Additionally, poverty and low parental education were identified as risk factors for obesity. Among daughters, poor parental maintenance of the home predicted obesity (J. G. Johnson, Cohen, Kasen, & Brook, 2002).

Disordered Eating and Family Functioning

Because there is limited research on the relationship between family characteristics and overweight, and because of the strong association between overweight and disordered eating, we look to the literature on disordered eating to help clarify the role of family functioning in overweight. Extensive research has shown that children and adolescents with disordered eating behaviors and attitudes are more likely to experience pervasive conflict and negativity in family relationships. Bonne et al. (2003) found that young women with BN reported lower family cohesion and adaptability than did peers without the disorder, and that the BN patients had a significantly poorer perception of these qualities than did their parents. Compared to families where eating disorders are not present, families of adolescent and young adult women with eating disorders experience higher conflict, are more extremely enmeshed in or disengaged from each other's lives (C. Johnson & Flach, 1985), and experience less involvement and greater isolation and detachment (Humphrey, 1986).

More recently, Johnson, Cohen, Kasen, and Brook (2002) compared various measures of childhood adversity with subsequent disordered eating behaviors during adolescence or young adulthood. Findings confirmed that physical neglect during childhood was a significant risk factor in the development of eating disorders, strict dieting behavior, and self-induced vomiting. Low paternal affection, communication, and

time spent with child predicted other unhealthy weight loss behaviors. Specifically among the daughters, inadequate parental supervision predicted unhealthy weight loss behaviors, and low paternal assistance to the mother also predicted development of eating disorders (J. G. Johnson et al., 2002).

Family Structure and Family Functioning

In order to further narrow the literature on overweight children and family characteristics, we consider the research on family structure, searching for the patterns of family functioning discussed above. Non-intact families tend to suffer from poor interpersonal relationships more so than intact families, and these problems are often compounded with the financial strains associated with single parenthood. Nair and Murray (2005) observed that divorced mothers used a less nurturing and less positive parenting style than non-divorced mothers in intact families. College women from non-intact families rate both biological parents more negatively than do women of intact families (Kilmann, Carranza, & Vendemia, 2006). Compared to children from intact families, children from divorced families tend to display more stress and feelings of anger (Cooney, Smyer, Hagestad, & Klock, 1986), as well as emotional vulnerability, which is particularly common in boys who have experienced multiple family transitions (Martinez & Forgatch, 2002).

Of the 81 million family groups reported in the US in 2006, 16% were headed by single parents (United States Census Bureau). Nearly one-third (four million) of the single-parent families were living below the poverty level. The economic conditions and stress exposure of living in poverty have been cited for many differences between children of intact and non-intact families, including increased adolescent depression

(Gore, Aseltine, & Colton, 1992) and loneliness (Garnefski & Diekstra, 1997). Maternal employment difficulties are associated with poor self-esteem in adolescent children (Kalil & Ziol-Guest, 2005). Researchers have also tied the financial strains of single-parenthood with parental depression, which leads to poorer parenting skills and results in various emotional, behavioral, and cognitive problems in children (Jackson, Brooks-Gunn, Huang, & Glassman, 2000).

Family Structure and Overweight

Given that non-intact families suffer from many of the negative qualities found in families with overweight individuals, it is reasonable to expect that family structure may have a more direct relationship with overweight. The single-parent family tendency toward low income may also limit the availability of healthy food options. The least expensive foods are often highest in fats, oils, grains, and energy density, and are cheapest to produce and buy (Drewnowski & Darmon, 2005). This problem may be exacerbated by data suggesting that lower-income children tend to eat larger portion sizes during meals (Ebbeling et al., 2004; McConahy, Smiciklas-Wright, Birch, Mitchell, & Picciano, 2002).

Strauss and Knight (1999) found that among families representing many classes in the labor market, children living with single mothers were more likely to become overweight than were peers living with married parents, but this predictive value became insignificant after adjusting for variables such as family income and maternal BMI and education. In a similar study, Veugelers and Fitzgerald (2005) found that children living in the middle- and highest-tertile income neighborhoods were less likely to develop obesity than were children in the lowest-tertile income neighborhoods. The likelihood of

developing obesity was greater for children living with separated, divorced, widowed, and single parents than for children of married parents, but not significantly so. However, in a comparison of data gathered over the past 30 years (Freedman et al., 2007), several inconsistencies emerged. Specifically, black children demonstrated no relationship between family income and overweight until 1999, after which the association was positive. Researchers consistently found a negative relationship in white children, but the strength of the association changed at various time points. More research is necessary to clarify the relationships between family structure, socioeconomic status, and pediatric overweight.

Emotion Regulation

Emotion Regulation Theory may be one approach to understanding disordered eating as a response to negative affect, which often emerges in poor family environments. Individuals employ many different techniques for regulating emotion, including both adaptive and maladaptive behaviors (Eisenberg & Spinrad, 2004). Disordered eating behaviors, whether or not they lead to overweight, may be considered a maladaptive emotion regulation technique (Arnow, Kenardy, & Agras, 1995). Parker and Keim (2004) offer anecdotal reports from overweight women discussing their food-related disturbances. One common reason the women reported overeating during childhood was to take their mind off their problems, which were often related to the economic stressors of living in poverty. Tice, Bratslavsky, and Baumeister (2001) found that among individuals in a distressed state, those who believed their mood to be changeable consumed greater amounts of fattening foods than did those who believed their mood to

be fixed. The authors concluded that eating fattening foods was a strategy aimed at improving the distressed mood.

Much research has examined mood regulation and binge eating, manifest as sub-clinical behavior, or in the context of diagnosed BN or BED. Telch and Agras (1996) demonstrated that overweight adults in a negative mood, as compared to overweight peers in a neutral mood, experience a loss of control over eating, and that this loss of control is correlated with greater caloric content. Research by Whiteside et al. (2007) suggests that adults with binge eating have less emotional clarity and fewer strategies for regulating emotion than those without binge eating behaviors. Another study further tested the hypothesis that binge eating and, when applicable, subsequent compensatory behaviors serve to reduce negative affect and/or increase positive affect (Lynch, Everingham, Dubitzky, Hartman, & Kasser, 2000). The authors report that prior to binges, increased negative affect was found in individuals who also used a compensatory behavior, as compared to those who binged without compensating. Contrary to expectations, binge eating increased negative affect and decreased positive affect. However, negative affect was significantly reduced prior to and following compensatory behaviors, suggesting the compensatory behavior is critical to emotion regulation in some individuals.

Women with AN and BN report lower sense of competence with regard to regulating negative mood than normal female controls (Gilboa-Schechtman, Avnon, Zubery, & Jeczmien, 2006). Villejo, Humphrey, and Kirschenbaum (1997) extended on the foundation that individuals with BN have strained family relationships and conducted research on the emotionality of family relationships related to eating patterns. They found

that individuals with BN, after having aroused previously-internalized family experiences, were hungrier than both bulimic peers in a neutral state, and normal-eating controls with the same family experience activation.

A number of studies have reported that eating in response to negative affect is common among adults with BED (Grilo, Masheb, & Wilson, 2001; Pinaquy, Chabrol, Simon, Louvet, & Barbe, 2003; Tanofsky, Wilfley, Spurrell, Welch, & Brownell, 1997). It appears that negative affect is also associated with loss of control eating in children (Goossens et al., 2007; Tanofsky-Kraff et al., 2007).

Research suggests that children who are raised in non-intact families experience poorer family functioning and report higher levels of negative affect than peers from intact families. Separate research has shown cross-sectional relationships among family functioning, negative affect, and disordered eating, and there is prospective evidence that poor family functioning may predict subsequent disordered eating behaviors. All four variables have some longitudinal evidence predicting overweight, with the strongest support for mood disturbance. In summary, family structure and functioning may impact psychological health, causing some individuals to cope with emotions through binge eating or other disordered eating behaviors. Such behaviors may, in turn, promote excess weight gain.

Study Purpose and Rationale

Many studies have demonstrated the relationships between overweight, psychopathology (including negative affect), and eating disorders. However, minor inconsistencies among the studies suggest that other relevant variables require study. Emotion regulation plays a role, such that individuals with emotional disturbances

develop disordered eating behaviors as a maladaptive method of coping with negative affect. Family functioning is also a promising candidate to account for some of the unexplained variance in the equation, as it appears to have its own relationships with overweight, psychopathology, and disordered eating. Family structure has a consistent association with family functioning, and is logically, if not empirically, linked to overweight. Research also has yet to draw a strong direct link between family structure and disordered eating, but the indirect link through family functioning suggests a potential connection. In the proposed study, we hypothesize that children from non-intact homes will report poorer family functioning, greater negative affect, and more disordered eating behaviors and cognitions than peers from intact homes. We also predict that two mediator models will explain the four variables under investigation, such that family functioning will mediate the relationship between family structure and negative affect, and negative affect will mediate the relationship between family functioning and disordered eating. Using an overweight sample largely controls the effects of weight status, allowing the variance from the remaining variables to be observed more clearly. A potential association with family structure would help healthcare providers identify children at risk for overweight and disordered eating.

Specific Aims and Hypotheses

The present study has three specific aims. First, to examine whether relationships exist between family structure, family functioning, negative affect, and disordered eating in a sample of severely overweight treatment-seeking adolescents. Based upon the associations identified in Specific Aim 1, Specific Aims 2 and 3 are to test models in order to a. determine whether family functioning mediates the relationship between

family structure and negative affect and b. test the hypothesis that negative affect mediates the relationship between family functioning and disordered eating. These aims and corresponding hypotheses are described below.

Specific Aim One: To examine whether family structure, family functioning, negative affect, and disordered eating are related in a sample of severely overweight treatment-seeking adolescents. Based upon prior research, several relationships are expected to emerge between the variables being examined:

Family functioning and family structure. Adolescents from non-intact families will rate their families as functioning more poorly than peers from intact families.

Family functioning and negative affect. Family functioning will be inversely associated with negative affect, such that adolescents who report poorer family functioning will report greater negative affect.

Family functioning and disordered eating. Family functioning will be negatively associated with disordered eating, such that adolescents who report poorer family functioning will display greater disordered eating attitudes and behaviors.

Family structure and negative affect. Adolescents from non-intact families will report greater negative affect than peers from intact families.

Family structure and disordered eating. Adolescents from non-intact families will display greater disordered eating attitudes and behaviors than peers from intact families.

Negative affect and disordered eating. Negative affect will be positively associated with disordered eating, such that adolescents reporting greater negative affect will display greater disordered eating attitudes and behaviors.

Data analytic strategy for Aim One. A series of bivariate correlations will be conducted to test the hypothesized relationships between the primary continuous variables of interest: family functioning, negative affect, and disordered eating. Student t-tests will be used to examine differences between family structures (intact and non-intact) in family functioning, negative affect and disordered eating, and to compare participants with and without loss of control (LOC) eating on measures of family functioning and negative affect. A Fisher's Exact will be conducted to examine LOC eating status in relation to family structure.

Primary data analyses will include both sexes. However, research has shown that females outnumber males in mood disorder and eating disorder diagnoses (APA, 2000). Therefore, additional analyses will be split by sex. Differences and associations are considered significant when $p < 0.05$.

Specific Aim Two: The family structure – family functioning – negative affect model.

The second aim of the study is to test the relationships among family structure, family functioning, and negative affect. Existing research supports the notion that non-intact families may report poor family functioning, and that poor family functioning is associated with negative affect in adolescents. Therefore, we predict that family functioning will mediate the influence of family structure on negative affect.

Family structure. For this study, family structure has been dichotomized into *intact* (child raised by two biological or adoptive parents) or *non-intact* (all other possible family units, including families with divorced parents, stepparents, single parents, or other guardians (Burnside, Baer, McLaughlin, & Pokorny, 1986; Kilmann et al., 2006)). Family structure has been associated with correlates of disordered eating, including

depression (Gore et al., 1992), and poor family functioning (Kilmann et al., 2006). It has also been associated with pediatric overweight (Gibson et al., 2007), although the relationship may be better explained by maternal BMI or socioeconomic status (Strauss & Knight, 1999). Living in a single-parent family has recently been associated with the presence of eating disorders in adolescents (Pelaez Fernandez, Labrador, & Raich, 2007), and multiple family transitions (death, divorce, remarriage, etc.) has been correlated with boys' emotional vulnerability (Martinez & Forgatch, 2002). We expect to find increased negative affect in adolescents from non-intact families.

Family functioning. The Family Environment Scale's (FES; Moos, 1974) cohesion, expressiveness, and conflict subscales comprise the Family Relations Index (FRI), which will be used to measure family functioning in this study. Poor family functioning has been correlated with self-reported depressive symptoms (Fornari et al., 1999). We expect to find similar relationships with family functioning assessed using the conflict, cohesion, and expressiveness subscales of the Family Environment Scale.

Negative affect. The Children's Depression Inventory (CDI; Kovacs & Beck, 1977) will serve as proxy for negative affect in testing this model. As reported above, Fornari et al. (1999) reported a link between poor family functioning and depressive symptoms. This relationship was found using the adult Beck Depression Inventory, from which the Children's Depression Inventory was derived. We expect to find that higher scores on the CDI will be associated with non-intact family status and poorer scores on the FRI.

Data analytic strategy for Aim Two. Based upon the results from Specific Aim One, we will determine if family structure, family functioning, and negative affect are significantly

correlated with one another. If this is the case, a regression analysis will be conducted to determine whether family functioning serves as a mediator between family structure and negative affect (Baron & Kenny, 1986). First, the dependent variable (negative affect) will be regressed on the independent variable (family structure). Second, the dependent variable will be regressed on the independent variable and the proposed mediator (family functioning). Age, sex, race, socioeconomic status, and BMI z-score will be considered as covariates in the model and entered as additional independent variables in each regression equation. BMI z-score is determined based on age- and sex-specific standards from a national health study (Ogden et al., 2002). Relationships will be considered significant when $p < 0.05$.

Specific Aim Three: The family functioning – negative affect – disordered eating model. Specific Aim Three will test whether the relationship between family functioning and disordered eating is mediated by negative affect. Emotion Regulation Theory (Eisenberg & Spinrad, 2004) posits that individuals employ adaptive and maladaptive techniques to regulate mood. Disordered eating may be an example of a maladaptive mechanism used to cope with negative affect (Arnow et al., 1995), which may be present within poorly functioning families (Fornari et al., 1999). We hypothesize that negative affect will mediate the influence of family functioning on disordered eating.

Family functioning. Greater family conflict and lower cohesion and expressiveness have been correlated with greater risk of developing eating disorders in adolescence (Felker & Stivers, 1994). We expect that family functioning will be associated with disordered eating, but that a significant proportion of the variance will be explained by negative affect.

Negative affect. Negative affect is related to family functioning as described above, and it is relevant in a study examining disordered eating in obese adolescents. Research has demonstrated that among obese adolescents, depression correlates with binge eating severity (Isnard et al., 2003), diagnosis of BED (Glasofer et al., 2007), and LOC eating (Goossens et al., 2007). We expect to find similar relationships in this study.

Outcome measure: Disordered eating. The Eating Disorder Examination (Fairburn & Cooper, 1993) will provide data for all three outcome measures: Global score of disordered eating pathology, presence or absence of LOC eating, and frequency of LOC eating episodes in the past month. The EDE has been used in numerous studies, and is psychometrically sound (Cooper, Cooper, & Fairburn, 1989; Rizvi, Peterson, Crow, & Agras, 2000). We expect to find increased eating pathology in adolescents reporting poor family functioning and high negative affect.

It is predicted that negative affect will mediate the relationship between family functioning and disordered eating, such that family functioning will be associated with both negative affect and disordered eating, and that the influence of negative affect on disordered eating will account for a significant portion of the variance otherwise explained by family functioning.

Data analytic strategy for Aim Three. Based upon the analysis conducted in Specific Aim One, we will determine if family functioning, negative affect, and disordered eating are significantly correlated with one another. If this is the case, regression analyses will be conducted to determine if negative affect serves as a mediator between family functioning and disordered eating. Because disordered eating is being assessed with three constructs (EDE global score, LOC presence/absence, LOC frequency), two separate analyses will be

conducted. Binomial logistic regression will be conducted with the dichotomous presence or absence of LOC eating, and multiple regression will be conducted with the continuous EDE global score and with the frequency of LOC eating. Each analysis will follow the same steps described in the data analytic strategy for Aim Two.

Power Analysis

Although the sample size for the proposed study was pre-determined because the data are archival, power analysis was conducted using nQuery (Elashoff, 2005) to confirm that the study was adequately powered to detect the effects proposed in the current study. Previous research examining predictors of disordered eating using regression analyses found a significant R-squared increase of 0.41 (Casper & Lyubomirsky, 1997). Based on a multiple regression analysis with: a) three variables b) an expected R^2 increase of 0.40, c) a targeted power of 80% and d) an alpha-level of 0.05, the analysis would require a sample size of 44 per group (total N = 88 based on two groups – intact vs. non-intact family structure). Therefore, the sample size of 145 is sufficient for the current study.

METHOD

Participants

Participants were 145 overweight (BMI $\geq 95^{th}$ percentile for age and sex; Ogden et al., 2002) Caucasian and African-American adolescents (12-17y) who were recruited to participate in a double-blind, randomized, placebo-controlled safety and efficacy trial for weight-loss medication (Anon, 2005; McDuffie et al., 2004). Adolescents were recruited through posted flyers, newspaper advertisements, and letters to local physicians, and were included if their BMI was greater than the 95^{th} percentile for age and sex, and if

they presented with at least one obesity-related health comborbidity, such as hypertension, hyperinsulinemia, impaired fasting glucose, impaired glucose tolerance, or hyperlipidemia. Individuals were excluded if they had lost weight in the past two months, used an anorexiant in the past six months, or if they presented with a serious non-obesity-related medical condition, a history of substance abuse, or another psychiatric disorder that would disrupt the study protocol.

Procedure

Individuals were participating in a medication safety and efficacy trial conducted between 2002 and 2007 (McDuffie et al., 2004). Eligible participants were invited to the National Institutes of Health (NIH) for a series of outpatient and inpatient visits. At the first outpatient visit, the assent and consent forms were reviewed and signed by the participant and their parent or guardian, respectively. Additionally, baseline pre-treatment data were gathered from several procedures, including collection of urine and blood samples, body composition measurements, psychological questionnaires, a wrist x-ray, an exercise test, and a physical examination. Participants were then randomized to take one of two types of blinded medication, either orlistat or placebo, during a 6-month treatment phase. The treatment phase began and ended with a three-day inpatient visit.

Throughout the treatment phase, participants were asked to maintain a low-fat, low-calorie diet, to take a multivitamin supplement and either orlistat or placebo daily, and to complete a facilitated 12-week behavioral group program consisting of nutrition education, structured exercise, and behavior modification skills training. In the first 3 months of treatment, participants returned to the NIH for weekly outpatient visits (12-week group program). The participants then completed three monthly outpatient visits,

which were used to monitor health, weight change, exercise and diet planning, drug-related side effects, and treatment compliance, and included monthly blood samples and physical examinations.

After the main treatment phase (first 6 months), all participants were given the opportunity to take orlistat for another 6 months, returning for outpatient monitoring visits every 2 months. Researchers requested that participants return to the NIH every 6 months for 2 years after discontinuing orlistat treatment in order to monitor their body weight and health. For a complete description of this study see McDuffie et al. (2004).

All data used in the present study were gathered during baseline assessment, prior to any intervention.

Measures

Participants completed the following assessments during the first three-day inpatient visit.

Questionnaires

The *Family Environment Scale* (FES) assesses the social environment of the family as perceived by its members (Moos, 1974). The FES is a self-report measure consisting of 90 true-false items. Each item loads onto one of ten subscales, and the subscales are grouped into three major theoretical dimensions of the family environment. One dimension, Personal Growth, is made up of five subscales: Independence, Achievement Orientation, Intellectual-Cultural Orientation, Active-Recreational Orientation, and Moral-Religious. The Family Relations Index (FRI) includes the Cohesion, Expressiveness, and Conflict subscales. Finally, the System Maintenance dimension is composed of the Organizational and Control subscales.

Psychometric properties of the FES were collected using a sample of over 1,000 adults and adolescents from 285 families, such that three or more members of each family completed the instrument. Moos (1974) reported that internal consistency ranged from a Cronbach's alpha of 0.61 to 0.78 across the ten subscales. The FES has been used to assess the family social environment based on reports from one parent (Roosa & Beals, 1990), from both parents (Boake & Salmon, 1983), from adolescents (Boyd, Gullone, Needleman, & Burt, 1997), as well as from parents and children combined (Loveland-Cherry, Youngblut, & Leidy, 1989). For the purpose of the present study, we examined the FRI, which consists of the Cohesion, Expressiveness, and Conflict subscales. Cronbach's alphas for these subscales have been measured at 0.78, 0.69, and 0.75, respectively (Moos, 1990).

The *Children's Depression Inventory* (CDI) assesses symptoms of depression (Kovacs & Beck, 1977). The CDI is a 27-item self-report symptom-oriented scale designed for school-aged children and adolescents, aged 6 to 17 years. It has been validated in samples of African American and Caucasian children (Kovacs, 1992). The total score represents a sum of depressive symptoms, with each symptom represented in a subscale: negative mood, interpersonal problems, ineffectiveness, anhedonia and negative self-esteem. The cutoff score for clinical depression (a total score of 19 out of a maximum score of 54), represents the 90th percentile for children (Kazdin & Petti, 1982). The CDI is typically presented to the child in writing and/or may be read aloud by the administrator. Each item consists of three statements (e.g., I have fun in many things … I have fun in some things … Nothing is fun at all) from which the child selects the one that best describes the way he or she has felt or thought during the previous two weeks.

The CDI was validated with 1,252 elementary and middle school children, divided into six samples based on sex and the school they attended (Smucker, Craighead, Craighead, & Green, 1986). The Cronbach alpha coefficients obtained in these samples ranged from 0.83 to 0.89. A subsample of 77 male and 78 female fifth-graders was retested after a 3-week interval, and test-retest reliability coefficients were 0.77 and 0.74, respectively. Researchers caution that the CDI should not be used to diagnose depression; it should only be used to assess the severity of a child's self-reported dysphoria (Fristad, Emery, & Beck, 1997). For the present study, the total score will be used to represent a proxy for negative affect, as this score has been shown to accurately discriminate between depressed and non-depressed adolescents (Craighead, Curry, & Ilardi, 1995).

Hollingshead Index. The Hollingshead four-factor index (Cirino et al., 2002) is one of the most commonly used measures of socioeconomic status (SES). The index is based on the education and occupation reported by each parent or guardian in a family unit. An education value (from 1 = below 7th grade, to 7 = graduate training) and occupation value (ranging from 1 = menial labor, to 9 = major professional) is derived for each parent and entered into a weighted equation. In the equation, education values are multiplied by three, and occupation values by five, with the weighted values summed for a final result, which classifies the individual into one of five SES levels. The levels may reflect a single parent or guardian's score, or would be averaged if multiple caretakers are present in a given family.

Cirino et al. (2002) compared the Hollingshead Index with two other common SES measures: the Nakao and Treas scale from America (Nakao & Treas, 1994), and the Blishen, Carroll, and Moore scale from Canada (Blishen, Carroll, & Moore, 1987). The

Hollingshead Index's correlation with the Nakao and Treas scale was 0.81, and the correlation with the Blishen, Carroll, and Moore scale was 0.86. The Hollingshead Index's inter-rater reliability was 0.91, which was the highest among the three measures.

Interview

The Eating Disorder Examination version 12OD/C.2 (EDE; Fairburn & Cooper, 1993) is a semi-structured clinical interview that was administered to each participant to assess aberrant eating. The EDE diagnoses the DSM-IV-TR eating disorders (APA, 2000). Based on their responses to the EDE, participants are categorized with the presence or absence in the month prior to assessment of objective binge episodes (overeating with loss of control), subjective binge episodes (loss of control without objective overeating as assessed by the interviewer, but viewed as excessive by the interviewee), or objective overeating (overeating without loss of control) over the 28 days prior to assessment. The EDE generates four subscales of disordered eating psychopathology: dietary restraint (cognitive and behavioral restriction), eating concern, shape concern and weight concern, which are averaged to create a global score.

Interviewers undergo extensive training in the administration of the EDE and in developing positive rapport with adolescents. The EDE's interview-based, interactive nature allows for questions to be explained so that they are understood by each individual and so that age-related developmental differences may be addressed. Special care is taken and examples are provided to explain concepts such as "loss of control," or the sense of being unable to stop eating once started. For example, when a participant does not readily understand the concept of "loss of control," one of the standardized descriptions used is

that the experience is “like a ball rolling down a hill, going faster and faster” (Tanofsky-Kraff et al., 2004).

The EDE has good internal consistency ratings with subscale alphas ranging from 0.68 to 0.90 (Cooper et al., 1989), acceptable test-retest reliability with correlations of ≥ 0.70 for all subscales, and good inter-rater reliability for all episode types (Spearman correlation coefficients: ≥ 0.70) (Rizvi et al., 2000). In a sample of overweight adolescents specifically, the EDE displayed excellent inter-rater reliability, with intra-class correlations ranging from 0.87 to 0.98 on the subscale and total scores (Glasofer et al., 2007). The present study uses three measures from the EDE: 1. the global score, which provides a continuous measure of overall disordered eating pathology; 2. presence or absence of LOC eating, which includes any objective or subjective binge episodes occurring in the past month (objective overeating episodes and participants without any aberrant eating episodes were grouped as “no LOC” eating episodes); 3. frequency of LOC episodes in the past month.

Family Structure. All participants underwent a medical history gathered during a physical examination conducted by a pediatric endocrinologist or a pediatric nurse practitioner. Each parent/guardian and adolescent were asked who lives with them in the home to determine family structure. For the present study, family structure was dichotomized into *intact* and *non-intact*. In an *intact* family, the child was raised by two parent figures, either biological or adoptive. All other possible family structures (single parents, divorced or separated parents, grandparents, or other guardians raising the children) were combined under the *non-intact* label (Burnside et al., 1986; Kilmann et al., 2006).

Physical Measures

Body Mass Index (BMI). Each adolescent's height was measured three times to the nearest millimeter by a stadiometer (Holtain, Crymmych, Wales) calibrated to the nearest millimeter before each height measurement. Each participant's weight was measured to the nearest 0.1 kg with a calibrated digital scale (Scale-Tronix, Wheaton, IL). Height and weight measurements were conducted after a 12-hour fast, and children were clothed but with shoes removed. Height and weight were used to compute BMI (kg/m^2).

Preliminary Data Inspection

Preliminary data inspection revealed that only 28% of the sample (60 of the original 215 participants) had complete data sets. Because the resulting sample size did not meet the minimum requirement determined by the power analysis and the present study made use of archived data, a multiple imputation method was conducted. In examining the pattern of missing data, two groups emerged: 86 participants were only missing data from the FES, and the remaining 69 participants showed highly variable patterns, missing as few as one and as many as eight different data points. We determined that imputing data only for the 86 participants missing FES scores was the most conservative method of analyzing an adequate sample size while minimizing possible confounds introduced by data imputation. Using *Amelia II* software (Honaker, King, & Blackwell, 2007), FES scores were imputed to create five data sets. Given the rate of missing information in the original data set, five sets of imputed data yielded an estimate that was roughly 98% efficient (Schafer, 1997). Analyses of family functioning were then conducted with each imputed data set, and the results were combined, yielding an overall

t-value and degrees of freedom (Schafer, 1997). Multiple imputation methods required a modified method of determining the degrees of freedom when computing the effects of the covariates in the regression models. Such modifications are acceptable when the complete-data degrees of freedom are relatively small and there is only a modest proportion of missing data (Barnard & Rubin, 1999). Linear associations between variables were described using Pearson correlation coefficients, and the overall or combined significance of the associations was evaluated with t-test and standard errors derived from simple linear regressions with the dependent variable regressed on the independent variable of each model (Snedecor & Cochran, 1989).

RESULTS

Participant Characteristics

The majority of the participants were African-American (59.3%) females (66.2%) (see Table 1). The average age of the participants was 14.5 $\pm$ 1.43 years, and BMI z-scores ranged from 1.67 to 3.30, confirming that all participants were at or above the 95th percentile for BMI according to age- and sex-specific standards (Ogden et al., 2002). The participants were evenly distributed between intact (49%) and non-intact (51%) families, and fell into a roughly normal distribution of SES: 9.0% in the highest class, 19.4% in class 2, 46.5% in class 3, 34% in class 4, and 1.4% in the lowest class. Forty adolescents (27.6%) endorsed any LOC eating in the past month, and the average EDE global score was 1.17 (*SD* = 0.82, Min = 0, Max = 4.27). There was a wide range in frequency of LOC episodes reported in the past month (Min = 0, Max = 40), but the average was at the low end of the range (*M* = 1.21, *Mdn* = 0, *SD* = 4.19). Depression scores ranged from 0 to 26

(*M* = 6.83, *SD* = 5.32), and Family Relationship Index values ranged from 5.49 to 26.47 (*M* = 17.22, *SD* = 4.21).

Aim One: Associations between family structure, family functioning, negative affect, and disordered eating.

For a graphical representation of the hypothesized relationships between each variable, see Figure 1.

Family functioning and family structure. There was no difference in family functioning between individuals from intact or non-intact families, $t(12) = -0.91$, $p = .38$ (one-tailed; all p-values are one-tailed unless otherwise specified). These comparisons, as with all non-significant full-sample analyses, yielded no gender differences.

Family functioning and negative affect. A significant negative correlation was found between family functioning and negative affect, such that poorer family functioning was associated with greater negative affect. After combining the test results from the five imputed sets, the overall t-test of the correlation coefficient was significant, $t(21) = -3.12$, $p = .005$. This relationship was significant in males, $t(21) = -3.38$, $p = .003$, but not in females, $t(20) = -1.60$, $p = .13$. Further, statistical significance in the overall model remained after controlling for age, race, SES, and BMI z-score in the regression model, $t(22) = -3.47$, $p = .002$. Age was the only covariate to be significantly associated with negative affect in the overall model, $t(120) = 2.18$, $p = .03$ (two-tailed), such that older individuals reported greater negative affect. This relationship was found in females, $t(82) = 2.28$, $p = .03$, but not in males, $t(33) = 0.40$, $p = .69$.

Family functioning and disordered eating. There was no correlation between family functioning and EDE global score or frequency of LOC episodes in the past

month. After combining the test results from the imputations, the overall t-test of the correlation coefficient for EDE score was not significant, $t(13) = 0.22$, $p = .83$, nor was the test of LOC frequency, $t(9) = -0.18$, $p = .86$. Likewise, there was no significant difference in family functioning between individuals who endorsed or denied LOC eating in the past month, $t(7) = 0.19$, $p = .86$.

Family structure and negative affect. There was no significant difference in negative affect between individuals from intact families ($M = 7.00$, $SD = 5.62$) as compared to those from non-intact families ($M = 6.68$, $SD = 5.05$), $t(143) = 0.37$, $p = .72$.

Family structure and disordered eating. When comparing individuals from intact versus non-intact families, there were no significant differences in EDE global score ($t(143) = 0.08$, $p = .94$), LOC endorsement in the past month (Fisher's Exact test of significance = 0.126), or LOC frequency in the past month ($t(143) = -0.09$, $p = .93$).

Negative affect and disordered eating. There was a significant positive correlation between depressive symptoms and EDE global score, $r = .45$, $p < .001$, and between CDI total score and LOC frequency, $r = .39$, $p < .001$, such that individuals with greater negative affect reported greater disordered eating cognitions and behaviors in the past month. Similarly, participants who endorsed LOC eating in the past month also displayed higher CDI scores ($M = 9.40$, $SD = 5.66$) than those who denied LOC eating ($M = 5.86$, $SD = 4.87$), $t(143) = -3.74$, $p < .001$. Each of these relationships was significant in females, but not in males. The correlation between EDE and CDI was significant in females ($r = .54$, $p < .001$), but males' correlation only trended toward significance ($r = .23$, $p = .06$). The sex difference was consistent when comparing CDI with LOC frequency, such that females had a significant correlation ($r = .49$, $p < .001$) and males

did not (r = -.04, p = .40). Males who endorsed LOC eating in the past month (M = 6.50, SD = 3.93) did not significantly differ on CDI scores ($t(47) = 0.14$, p = .89) from those who denied LOC eating (M = 6.73, SD = 5.81), whereas females showed a marked difference (present: M = 11.33, SD = 5.87; absent: M = 5.46, SD = 4.36; $t(94) = -5.22$, $p <$ .001).

Aim Two: Test of the family structure – family functioning – negative affect model

As described in the Methods, in order for a variable to mediate an existing relationship, associations must be present between each of the three variables in the proposed model (see Figure 2). Although the results of this study demonstrated a link between family functioning and negative affect, family structure was not found to be related to either variable. Because only one of the three relationships was significant, family functioning could not be considered as a mediator, and it was inappropriate to proceed with testing a mediator model.

Aim Three: Test of the family functioning – negative affect – disordered eating model

Although negative affect was significantly associated with both family functioning and disordered eating, this study found no relationship between the latter two variables. Therefore, the initial requirements for a mediator model (Figure 3) were not met, and no further meditational analyses were conducted.

DISCUSSION

Summary of Findings

The main purpose of this study was to determine the relationships among family structure, family functioning, negative affect, and disordered eating in overweight

adolescents. Two mediator models were hypothesized based on previous research findings.

Aim One: Preliminary associations

Family structure was not related to any other variable examined. Family functioning was correlated with negative affect, but only in males. Negative affect was associated with measures of disordered eating, but only in females. There was no direct relationship between family functioning and disordered eating. Each of these results is considered and explained below.

Family structure. The results of this study suggest that family structure has no inherent influence on any of the variables under investigation. We hypothesized that adolescents from non-intact families would have lower Family Relation Index scores, signifying poorer family functioning, than peers from intact families. This hypothesis was based on previous findings that non-intact families may be associated with less nurturing and less positive parenting style (Nair & Murray, 2005), and that children from non-intact families rate their parents more negatively than do children from intact families (Kilmann et al., 2006). Similarly, we predicted that youth from non-intact families would display more negative affect than those from intact families. This expectation was based on research demonstrating that children from non-intact families display more stress and feelings of anger (Cooney et al., 1986), as well as emotional vulnerability (Martinez & Forgatch, 2002), depression (Gore et al., 1992), and loneliness (Garnefski & Diekstra, 1997) as compared to peers from intact families. We also hypothesized that non-intact family structure would be associated with increased disordered eating behaviors and cognitions, a prediction which was based on research linking non-intact family structure

with overweight (Gibson et al., 2007; Strauss & Knight, 1999), and overweight with disordered eating (Morgan et al., 2002; Tanofsky-Kraff et al., 2005; Tanofsky-Kraff et al., 2004). One recent study also found an association between non-intact family structure and eating disorders in adolescents (Pelaez Fernandez et al., 2007).

Inconsistent with our hypotheses, none of the analyses involving family structure found any significant relationship. This is plausible in the context of prior research, which found that many aspects of children's lives cannot be explained solely by the parents' marital status (Spruijt, DeGoede, & Vandervalk, 2001). The outcome measures in the Spruijt et al. study included physical condition, parental bonding, relational development, risky habits, plans for future family, and problems with learning, work, and relationships. They found that the quality of the marriage, as reported by the child, had more bearing on child's outcome variables than did the family structure itself. Their study examined intact families, as well as widowed and divorced single-parent families and step-families resulting from divorce. Intact families were further divided based on the child's assessment of the parents' marriage quality. A crude tally of the family rankings on each variable in Spruijt and colleagues' study demonstrate that children fare best when coming from an intact family with a good marriage, and they fare worst coming from an intact family with a bad marriage. Single-parent widowed families appear to be a relatively good environment to raise children, and the other three family types clump together with worse scores. The lack of group (intact vs. non-intact) differences in family functioning scores in the present study seems to support the notion that a simple dichotomy of intact versus non-intact structure is an insufficient grouping method when seeking to draw out true differences in family quality. Because of literature

demonstrating superior outcomes for intact families over single-parent, divorced-parent, step-parent, and other non-intact family types (Garnefski & Diekstra, 1997; Gore et al., 1992; Kilmann et al., 2006), the dichotomy was applied to the current sample. Further, the non-intact group could not be separated for more detailed comparisons because such information was not consistently available in the archived data set, and the decreased sample sizes would have yielded insufficient power for data analysis.

It is especially important to move away from the current family structure labels when discussing the African-American population, as the term *non-intact* may convey a pejorative suggestion that families not run by two married parents are less common, and thus possibly "abnormal" or inherently worse than intact families. A comparison of family types by race in this sample suggests that "non-intact" families are, in fact, more common for African-American adolescents (see Table 4). U.S. census data confirms that this pattern extends to the larger population as well (United States Census Bureau, 2007).

Negative affect. Although it was not related to family structure, negative affect proved to be significantly related to the two remaining variables in the study, and with a different explanation for each relationship. Results confirmed the hypothesis that CDI score would be negatively correlated with family functioning, but this relationship was only demonstrated in boys. This finding confirms prior research that children of poorly-functioning families exhibit greater depression than peers from normal-functioning families (Bouma, Ormel, Verhulst, & Oldehinkel, 2008), and that family relationship problems may be a risk factor for depression (Gore et al., 1992; Haavisto et al., 2004). Although each study found a relationship between family functioning and negative affect, sex effects were inconsistent: one sampled only male adolescents (Haavisto et al., 2004),

one was almost entirely female (Fornari et al., 1999), one sampled both boys and girls and found the relationship stronger in females (Bouma et al., 2008), and one found no sex differences (Gore et al., 1992).

As predicted, negative affect was associated with all three measures of disordered eating: presence/absence of LOC eating, frequency of LOC eating, and the EDE global score. These results add to a strong body of evidence that depressive symptoms correlate with LOC and other disordered eating behaviors (Glasofer et al., 2007; Patton et al., 1997; Tanofsky-Kraff et al., 2007; Telch & Agras, 1996) and cognitions (Morgan et al., 2002), and particularly so among overweight samples (Goossens et al., 2007; Isnard et al., 2003). In the current sample, each of these relationships was found in females, but not in males. Although there is abundant research supporting the connection between depressive symptoms and disordered eating in overweight adolescents, none of the cited studies reported any sex differences moderating that relationship. However, disordered eating is reported more often in girls than in boys, with estimates ranging from 2:1 to 10:1 (Croll, Neumark-Sztainer, Story, & Ireland, 2002; Hautala et al., 2008; Hoek & van Hoeken, 2003), so it is not surprising that we would find the same trend in this sample.

Family functioning and disordered eating. Despite each variable's connection with negative affect, there was no direct relationship between family functioning and disordered eating. Most of the research upon which the hypotheses were derived found that differences in family functioning were related to particular eating disorder diagnoses (Bonne et al., 2003; Humphrey, 1986; C. Johnson & Flach, 1985), but there is a very limited body of research investigating sub-threshold disordered eating behavior and overall family functioning. One study found that physical neglect, low paternal affection,

and other family-related variables during childhood were linked to unhealthy dieting and weight-loss behaviors in adolescence or young adulthood (J. G. Johnson et al., 2002). Although family functioning and disordered eating were measured differently in that study, it provides a foundation to expect similar relationships in the current study. It is possible that because the sub-threshold eating behaviors and cognitions reported by participants in this study were not severe enough to warrant diagnosis, that any problems in family functioning were likewise not severe enough to be distinguished from those without disordered eating.

Aim Two: Test of the family structure – family functioning – negative affect model

Only one of the three pairs in this model was significantly associated, thus the basic criteria for mediation were not fulfilled. Although this suggests that the proposed mediation model is incorrect, there is also reason to believe the problem lies in operationalizing the variables, namely family structure. As was discussed above, Spruijt et al. (2001) found no clear advantage to any outcome variable based on family structure alone. Their work suggests that single-parent homes are not inherently worse than two-parent homes, and that the cause of marital break may be associated with the quality of the child-rearing environment. Because parent death or divorce was not assessed in the current sample, the non-intact group could not be meaningfully separated to mimic Spruijt et al.'s design. As it is defined in the present study, family structure is not related to any other variable, and clearly does not belong in the present model in our sample.

Aim Three: Test of the family functioning – negative affect – disordered eating model

The correlation between family functioning and negative affect was only present in males in the current study, consistent with Haavisto and colleagues' (2004) research,

which used a sample limited to male adolescents. Fornari et al.'s (1999) study included only 5% males, precluding any sex comparisons from that sample but suggesting that the link may not be exclusive to males. However, this sample included only adolescent and young adult patients diagnosed with eating disorders, so the results may not be directly applicable to others with sub-threshold disordered eating or general community populations. Although Gore et al. (1992) found that females were more likely than males to suffer from depression, they reported no sex differences in the positive association between family problems and depressed mood. Bouma et al. (2008) reported modest sex differences in the correlation between family functioning and depression, but these are opposite to the present findings, such that family functioning was more often related to girls' depression than to boys'. In the current treatment-seeking overweight sample, female adolescents' depressive symptoms were more strongly related to their disordered eating, whereas males' depressive symptoms were more strongly related to their family environments. Past research would also suggest that overweight may influence depression, especially in treatment-seeking individuals (Flodmark, 2005; Wardle & Cooke, 2005). No correlation with BMI z-score was found in this sample for either gender, possibly because all participants were at or above the 95th percentile for BMI, reducing the variability in the sample and statistically disguising any relationship that may be present (Isnard et al., 2003).

To better understand the sex differences in our results, we compared males and females on each variable included in the model, including the covariates used in the regression analyses. The only significant difference found was that, as expected, males had higher BMI z-scores (M = 2.67, SD = 0.26) than females (M = 2.43, SD = 0.31).

Although the mean difference is statistically significant, it may not be clinically informative. Both of those z-scores correspond to the 99th percentile, so any social and health consequences are likely negligible.

The hypotheses in this study were driven by Emotion Regulation Theory (Eisenberg & Spinrad, 2004). In this study, we conceptualized the home environment as a stressor that prompts negative affect, which is then maladaptively regulated via eating behaviors. This theory has been used to explain loss of control eating (Telch & Agras, 1996), binge eating (Whiteside et al., 2007), and compensatory behaviors (Lynch et al., 2000). Poor emotion regulation has been identified in patients with AN and BN (Gilboa-Schechtman et al., 2006), and it has been linked with eating behavior in adults with BED (Grilo et al., 2001; Pinaquy et al., 2003; Tanofsky et al., 1997). At least one study has identified family relationships as a source of negative affect that triggered disordered eating (Villejo, Humphrey, & Kirschenbaum, 1997). In the current sample, family environment was only associated with negative affect in boys, and this subsample did not use eating as an emotion regulation technique. Conversely in girls, eating was related to negative affect, but the mood was not significantly associated with family environment. Therefore, the results of this study indicate that Emotion Regulation Theory is supported in overweight adolescent girls, although the trigger for negative affect was not identified.

Implications

The intended implication of this study was to inform prevention efforts as healthcare providers target overweight and disordered eating. Finding a role of family structure would have identified an easily isolatable demographic toward which prevention measures could be focused. However, the lack of significant findings means

that healthcare providers have to continue to target established risks for disordered eating. The results of this study confirm other data demonstrating that, in treatment-seeking overweight adolescent females, increased negative affect may be an effective marker for disordered eating.

The relationship between family functioning and negative affect in males confirms the role of social factors correlated with depression, which affects approximately 11% of males under 25 years old (Kessler, McGonagle, Swartz, Blazer, & Nelson, 1993). Clarifying the role of family relationships will improve mental health providers' ability to understand and treat mood disorders in this population.

Limitations

There are several limitations to this study. One limitation is the amount of missing data present in our sample. However, multiple imputation is the preferred method for handling missing data for two main reasons: 1. its sophisticated algorithm predicts values for missing data based on patterns in the other variables for each case, as opposed to simply filling each hole with a median value; and 2. it creates multiple sets of imputed data, greatly reducing the likelihood that a single "wrong guess" would skew the results (Schafer, 1997). Further, diagnostic checks of the imputed data sets, which included convergence of values of overdistributed sets and confidence intervals of overimputed sets, confirmed that the imputations were composed of a distribution of reasonable estimates for data based on the existing values.

Another limitation is the cross-sectional design. Although two important relationships were observed in this investigation, between negative affect and both family functioning and disordered eating, causality cannot be determined without a prospective

analysis. However, the data in this study were gathered as part of a longitudinal clinical trial, and the treatment effects would have confounded the results of the hypotheses examined here.

Because one of the inclusion criteria was BMI at or above the 95th percentile for age and sex, the entire sample was overweight. This limits the generalizability of the study to treatment-seeking overweight adolescents with an obesity-related health comborbidity, and does not offer any information on the eating cognitions and behaviors of non-overweight youth. Using a selective sample such as this may also bias other variables under investigation. Given that overweight has been linked to negative affect (Braet et al., 1997; Zametkin et al., 2004), particularly in treatment-seeking individuals (Flodmark, 2005; Wardle & Cooke, 2005), it is possible that the negative affect scores of our sample may have been skewed toward the higher end of the range. Similarly, overweight may have biased the disordered eating data in such a way as to display greater pathology (Tanofsky-Kraff et al., 2005; Tanofsky-Kraff et al., 2004). Aside from skewing these measures in a certain direction, this homogenous sample may have reduced variability in the data, thereby masking relationships that would have otherwise been identified.

Finally, the definition of family structure used in this study may have been too broad. As Spruijt et al. (2001) demonstrated, family structure may have no inherent differences in quality of relationships, life satisfaction, or other characteristics. A more distinct definition of family type, based on a combination of parents' marital status and quality of relationships, might yield more meaningful differences in the outcome variables used here.

Future Directions

In order to better test Emotion Regulation Theory to explain the relationship between family environment and disordered eating, alternative research procedures from the current study should be considered. Instead of assessing negative affect and disordered eating with a retrospective interview or self-report, more immediate measures should be used. Assuming that family environments are relatively stable over time (Moos, 1990), the variables of interest are the current affective state and associated eating behaviors and other mechanisms used to cope with emotions. Ecological momentary assessment may be an effective tool to collect this type of data (Shiffman, Stone, & Hufford, 2008). This assessment method employs multiple data collection procedures including diaries, telephonic surveys, and physiological sensors. Measuring mood and behavior in real-time, in the individual's natural context, and in a more constrained time period, may allow for stronger conclusions about the causality of the relationship.

With the modifications described above, this study should be replicated with non-overweight and non-treatment seeking overweight youth in order to eliminate the possible influences due to the homogeneity of the current sample. Broadening the sample may also clarify whether the sex differences identified in this study are true across the population or are isolated to the participants in this study.

In conclusion, this study confirms that poor family functioning is associated with increased negative affect, and that increased negative affect is associated with increased disordered eating cognitions and behaviors. However, because those two relationships were not found in the same sample, it is impossible to connect all three variables based on the current results. Additionally, these results demonstrate that family structure, based

on the current operational definition, has no meaningful role among the other variables examined in this study. Therefore, our results suggest that it is the quality of the family relationship, as opposed to the family make-up, that is related to increased general and eating related distress.

Table 1

Participant characteristics (N = 145)

Variable and type	N	Percent
Gender		
Male	49	33.8
Female	96	66.2
Race		
Caucasian	59	40.7
African-American	86	59.3
Family Structure		
Intact	71	49.0
Non-Intact	74	51.0
Socioeconomic Status (N=144)		
Level 1 (high)	13	9.0
Level 2	28	19.3
Level 3	67	46.2
Level 4	34	23.6
Level 5 (low)	2	1.4

Variable	Mean	Standard Deviation
Age	14.50	1.43
BMI z-score	2.51	0.32

Table 2.

Group differences tested in Aim One

Variable	Mean	SD	Mean	SD	*t* (df)	*p*
			Family Structure			
	Intact		Non-Intact			
Family Functioning (FRI)	16.66	0.77*	17.42	0.89*	-0.91 (12)	.38
Depression (CDI)	7.00	5.62	6.68	5.05	0.37 (143)	.72
Disordered Eating (EDE)	1.17	0.82	1.16	0.82	0.08 (143)	.94
LOC frequency	1.18	4.93	1.24	3.36	-0.09 (143)	.93
			LOC Eating			
	Present		Absent			
Family Functioning (FRI)	16.86	1.33*	17.12	0.81*	0.19 (7)	.86
Depression (CDI)	9.40	5.66	5.86	4.87	-3.74 (143)	<.001

*Because multiple imputation analyses do not offer standard deviations, standard error of the mean has been substituted for family functioning statistics.

Table 3

Fisher's Exact test for LOC endorsement by family structure

	Family Structure	
LOC	Intact	Non-intact
Present	16 (11%)	24 (17%)
Absent	55 (38%)	50 (34%)

Note. Fisher's Exact test = 0.126

Table 4

Fisher's Exact test for family structure by race

	Family Structure	
Race	Intact	Non-intact
Caucasian	40 (68%)	19 (32%)
African-American	31 (36%)	55 (64%)

Note. Fisher's Exact test < .001

Figure 1. Proposed model to explain relationships between four variables in a sample of treatment-seeking overweight adolescents

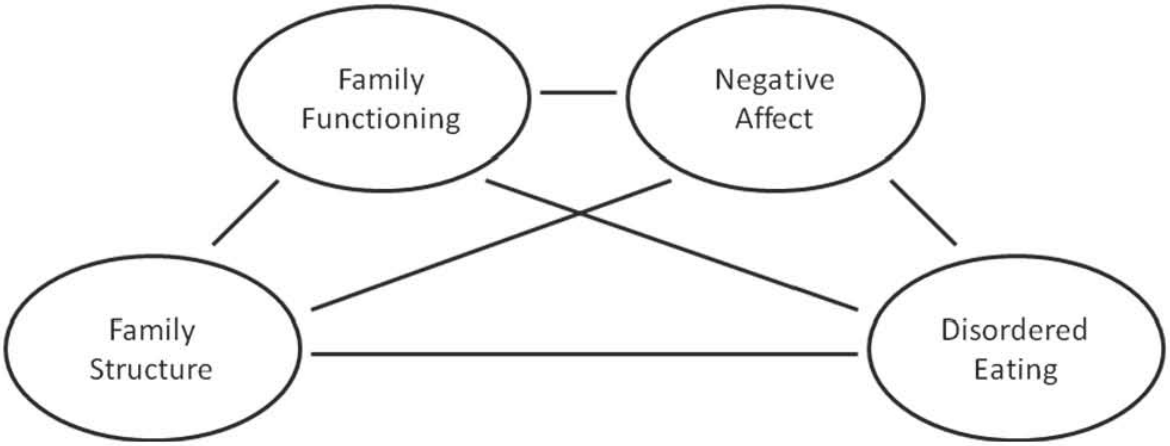


Figure 2. Proposed model for mediation relationship tested in Aim Two

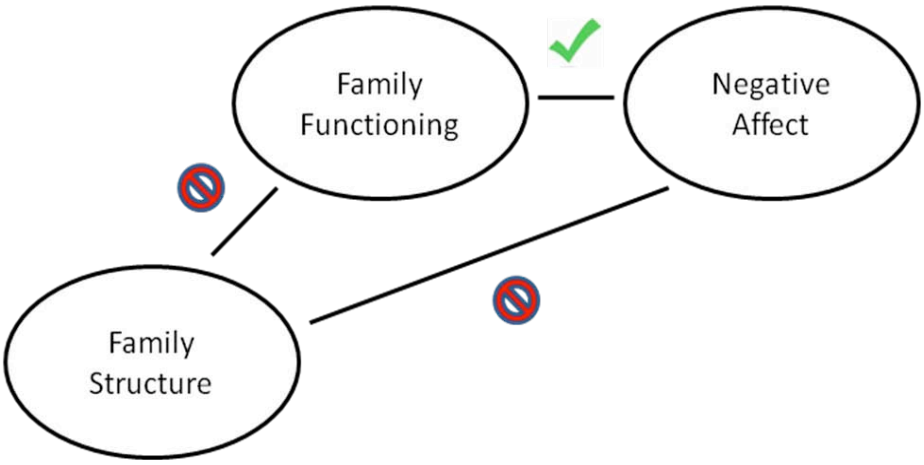
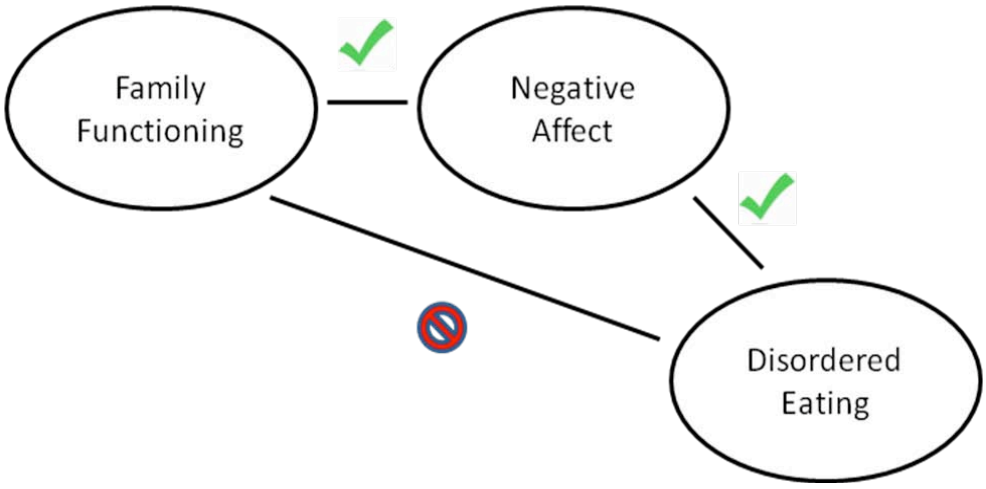


Figure 3. Proposed model for mediation relationship tested in Aim Three



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